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AGRICULTURAL VIABILITY AT THE URBAN FRINGE

by

Adesoji Adelaja
Kevin Sullivan*

<u>*Contact Address*</u>

Adesoji Adelaja
Department of Agricultural, Food and Resource Economics
Cook College, Rutgers University
55 Dudley Road
New Brunswick, NJ 08901
Tel: 732-932-9155 Ext. 24
Fax: 732-932-8887
Email: adelaja@aesop.rutgers.edu

*Adesoji Adelaja is also Associate Director of the Rutgers Ecopolicy Center and Associate Professor and Chair, Department of Agricultural, Food and Resource Economics, Cook College, Rutgers University. Kevin Sullivan is Economist, New Jersey Pinelands Commission and former graduate student, Department of Agricultural, Food and Resource Economics, Cook College, Rutgers University. This research is supported by funds appropriated under the Hatch and McIntire-Stennis Acts and by a grant from the New Jersey Department of Agriculture under the Farms Commission Implementation Project. This paper is designated New Jersey Agricultural Experiment Station Publication No. D-02532-6-98.

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Abstract

Enhancing the viability of agriculture is a critical agricultural policy objective at the urban fringe. Using New Jersey as a case study, this paper investigates the factors that contribute to the viability of urban fringe farms via a cash flow model. Results indicate that viability is directly related to gross sales and the extent to which a farmer grows higher valued crops, but is inversely related to indebtedness and farm asset value. Contrary to popular beliefs, off-farm income and revenues from land sale do not affect viability. Vegetable farms are less viable, *ceteris paribus*.

Findings suggest positive returns to formal education and an inverse relationship between operator age and farm viability. Farmers utilizing cooperative extension and related services and those adopting innovative marketing approaches exhibit significantly greater viability. Surprisingly, those that have adopted various innovative production practices appear less viable in the short-run. Local right to farm ordinances aimed at protecting farmers are largely ineffective, while right to farm conflicts significantly reduce the viability of farms. Given the trends in farming at the urban fringe, the results suggest the importance of farmland preservation and the encouragement of intensive high-value agriculture.

Key Words: Farm viability, urban fringe, right to farm, cash flow, farmland retention.

AGRICULTURAL VIABILITY AT THE URBAN FRINGE

Maintaining and enhancing the viability of agriculture is a critical objective of agricultural policy at the urban fringe. Farmers at the urban fringe are challenged by a number of factors, which make them more susceptible to failure. Urban fringe agriculture is unique not only in terms of its business climate, but also in terms of the market opportunities facing farmers and the issues they have to deal with in relation to neighbors, policy makers and regulators. The near-urban environment has several advantages that contribute to farm viability. However, it also imposes significant costs that detract from the long-term viability and sustainability. To develop effective policies to enhance agricultural retention, policy makers need information on the factors that enhance or detract from viability, especially those policy factors that can be targeted to facilitate economic competitiveness.

On the positive side, the near-urban environment offers farmers a unique access to urban markets, lower transportation costs, higher prices, and the opportunities for direct marketing (through farm stands, roadside markets, farmers' markets, direct sales to supermarkets, etc.). The environment also offers the opportunities to produce a range of high value products (e.g. ornamentals, nursery products, vegetables, fruits, exotic animals, etc.) which may translate into higher profits. The near urban environment allows access to off-farm jobs and the opportunities for supplemental income from entertainment agriculture (Lopez, Adelaja and Andrews 1988). These benefits can add considerably to the success of farms.

On the negative side, however, the urban fringe often implies higher costs of doing business. Inputs such as insurance, labor, utilities, property taxes, and raw materials are generally more costly than in other states (Adelaja, Miller and Taslim 1998). Farmers at the urban fringe also face higher and ever escalating land values which not only result in higher property taxes, but also in the direct loss of farmland to development (Lopez, Adelaja and Andrews 1988). For example, between 1950 and 1995, land values in New Jersey increased at least fifteen-fold. Increases in farm cash receipts lagged way behind. High land values shorten the planning horizon of farmers and create an "impermanence syndrome" which discourages investments in new machinery, technology, and infrastructure, especially those involving long-term commitment, and that can affect long-term transformations in the competitiveness and success of farms (Lopez, Adelaja and Andrews 1988).

Farmers at the urban fringe also face nuisance complaints from their neighbors, stringent local and state regulations, and other problems (Adelaja et al. 1996). These result from the thinning of the ranks as non-farmers move into farming communities and exert greater influence on local planning, zoning, and land use policies. All of these have contributed to the rapid loss of farmland.

Determining how to encourage successful farming is complex. This complexity makes it necessary to unravel the various factors that affect the viability of urban fringe agriculture. An analysis of farm viability that takes into consideration the effects of policy related factors would be extremely helpful to policymakers, academics, and farmers. With knowledge about the determinants of viability, one can specifically target policy variables and tools to enhance viability. Policy makers need guidance as to what adds to agricultural viability for them to play an optimal role in the positioning of agriculture.

The objective of this paper is to conceptualize the factors that affect the viability of urban fringe agriculture and to estimate an empirical model that is capable of isolating the role of various factors in determining viability. New Jersey is used as a case study. The paper utilizes the standard viability model used by Adelaja and Rose (1988) to estimate the effects of factors related to farm size, productivity, location, education, socio-demographics, and attitudes on viability. A novel feature of this study is that it goes beyond the use of financial data and considers the effects of socio-demographic, attitudinal, and farm structure variables, as well as variables reflecting the environment in which urban fringe farmers operate.

The rest of this paper is organized as follows. Section 2 discusses the importance of viability at the urban fringe and compares viability enhancing initiatives to other agricultural retention policies. Section 3 reviews the framework for viability modeling. Section 4 describes the date sources and presents the empirical model estimated and the estimation procedures. Section 5 explains the empirical estimates resulting from the econometric model, and section 6 summarizes important findings and draws policy relevant conclusions.

IMPORTANCE OF FARM VIABILITY AT THE URBAN FRINGE

One of the reasons why the viability of agriculture is a critical farm policy issue at the urban fringe is the fact that farmland is being lost at alarming rates while the policy instruments typically used to retain farmland just do not provide sufficient relief. Policy makers recognize that the market benefits of agriculture do not reflect its full value to society. Hence, agricultural policy has sought to correct this externality by encouraging the retention of farmland. The public benefits of agriculture include clean air, clean water, water recharge, wildlife habitat, open space, decreased crime, decreased congestion, and a rural lifestyle. The rapid decline of agriculture in various urbanizing areas raises the value of these benefits to society. In addition, studies have shown that farmland is a good tax ratable. On the average, for each $1.00 of revenue generated by agricultural and forest lands, $.30 was expended while the ratio for the residential sector was $1.00:$1.14 (American Farmland Trust 1991). The loss of farmland to housing development ultimately results in higher property taxes (Adelaja, Schilling and Menzo; Adelaja, 1998). All of these help explain why farmland retention is an important policy objective at the urban fringe.

Various policy tools are used to retain farmland and open space at the urban fringe. These include farmland assessment, right to farm laws, farmland preservation, and agricultural zoning. The costs and benefits of these four policy instruments are discussed below in order to put agricultural viability in proper context.

Farmland assessment reduces the assessed value of farmland to its' "productive or use value" for the purpose of property tax calculations. It therefore reduces the loss of farmland by reducing production costs (Parks and Quimio 1996). Without farmland assessment, many farmers at the urban fringe will probably go out of business (Adelaja, Schilling and Menzo; Adelaja, 1998). However, farmland assessment does not necessarily stop conversion or permanently preserve farmland (Parks and Quimio 1996). Some of the staunch critics of farmland assessment believe that it may encourage speculation by reducing the cost of investing in land, and actually bolster urbanization in the long-run (Nelson1990).

Right-to-farm laws represent an attempt to protect farmers from private nuisance complaints that plague urban fringe farmers and shield them from inappropriate municipal and state regulations that are typical at the urban fringe. Conflicts between farmers and their non-farm neighbors center around trespass, vandalism, dust from crop cultivation, machinery noise, construction of direct marketing outlets, farm stands, and farm stores, smells from farm animals, application of manure and nutrients to soil, litter, farm vehicles on roads, and pesticide application (Adelaja et al. 1996). Right-to-farm laws are intended to keep farmers farming and thus help preserve agriculture or at least delay development. Conceivably, right-to-farm laws enhance the viability of farms. However, such laws are not a farmland preservation policy tool per se and are unlikely to preserve farmland in the long-run (Nelson 1990).

Efforts to permanently preserve farmland include purchase of development rights (PDR) and transfer of development rights (TDR). The benefit of these PDR and TDR is the permanent preservation of farmland. However, both have drawbacks. PDR is not widely accepted because it requires an exorbitant up-front cost and critics condemn it for rewarding landowners for property value derived from publicly financed capital improvements such as roads and sewer systems, producing enclaves for rich land owners, and not preserving the farming economy (Nelson 1992).

For example, Adelaja (1998) estimated that it would cost $3 billion to preserve all of the farmland in New Jersey. That amount is simply not affordable.

TDR programs, which establish a mechanism by which owners of preserved farmland can be compensated for the loss of development rights, require an enormous administrative capacity which may be too great to render it successful (Rose 1986). Additionally, TDR can negatively impact on land values. Also, land owners are not always fairly compensated due to the difficulty in allocating the credits equitably (Brennan 1996).

Agricultural zoning restricts land use to agriculture and other open space activity. It also specifies minimum lot sizes in agricultural areas. However zoning also has drawbacks. Adelaja, Derr and Rose (1989) revealed that zoning results in the devaluation of land and that this limits farmers' ability to borrow funds to invest in farming operations. Farmers are generally not supportive of zoning ordinances because of the devaluation effect, particularly in urban fringe areas where land is viewed as a commodity that can be sold off for financial security (Arendt 1994). In addition, zoning is not a permanent form of preservation; it can be reversed.

It has been argued that farmland at the urban fringe cannot be sustained long-term unless it is viable. Even with preservation policies in place, continued existence of a farm can not be guaranteed unless farming is viable. The decision to farm is largely an economic one. As long as development is a better option, farmers will always choose it over farming. If a farm is not economically viable, then there is no incentive for farmers to stay in business. Of course there is the "gentleman farmer" argument that presupposes that people would take the burden of a losing business just to live near open land. Some forty-four percent of the New Jersey farmers surveyed in the 1993 Survey of New Jersey farms indicated that if offered a fair market value for their land, they would sell at least some or all of their land. Only 49% of the farmers said they generated sufficient income, including off-farm income, to cover all of their business costs in 1993 (Adelaja, 1994). These statistics explain why it is optimal to encourage the improvement of viability.

Lapping and FitzSimons (1982) contended that it is essential for farmland retention programs to focus on economic viability. Indeed, enhancing farm viability may be the most important objective of agricultural policy makers at the urban fringe. As a farmland retention policy, this policy tool should continue to grow in importance over time (Adelaja and Schilling 1995). For agriculture to survive, farmers must make money and farming must have an economic base. [1] Otherwise agriculture will always yield to alternative uses of the land. In order to devise effective public policies to enhance the viability of agriculture, there is need to understand the factors that contribute to viable agriculture.[2]

VIABILITY MODELS

Farm viability has been the focus of several studies in the literature. Most of the studies were conducted in the 1980's when some of the farms in the Mid-west had difficulty turning a profit. While these studies provide a framework for evaluating the viability of agriculture, few have focused on viability issues at the urban fringe. Fletcher, Carley and Terza (1985) examined the effects of herd size, productivity per cow, operator experience, operator education, off-farm income, and type of farm enterprise on the variations in the debt/asset ratio of dairy farms in the southern states. Lines and Zulauf (1985) researched the factors associated with variations in the viability ratio of Ohio farmers. Smale et al. (1986) explored farm viability for farm households in Mississippi, Tennessee and Wisconsin, using the viability ratio as a measure of viability. Their study focussed on gross sales, acres farmed, productivity per cow for dairy farms, experience, education, and off-farm employment as determinants of viability. The Adelaja and Rose (1988) study of New Jersey farm household viability is the only study that focused on a near urban environment. While the issue of viability of agriculture is a critical one at the urban fringe, very little effort has been devoted to studying it.

The Adelaja and Rose (1988) article focused mainly on financial variables that affect the viability of agriculture, but included socio-economic and demographic variables. While Adelaja and Rose (1988) raised questions about the role of attitudinal variables in determining the viability of agriculture, they did not include information about such variables. Neither did they account for factors known to be important at the urban fringe such as regulatory constraints, market opportunities, right to farm conflicts, wild animal damage, chemical use, and land use zoning. With respect to farmers' attitudes about farming, attitudes about regulation appear to be of paramount importance (Adelaja et al 1996).

Previous studies did not include a number of these important factors because much of the data used was not originally collected with viability analysis in mind and did not contain information on the full range of factors that are expected to affect viability. While the Adelaja and Rose (1988) paper is an exception in that the data was collected through a survey intended for modeling viability, it did not go far enough with respect to farmers' opinions and attitudinal factors.

Modeling viability is essentially modeling the farm's financial structure. Viability models help to identify the determinants of viability and measure their effects on viability. Viability can be defined as the ability of a farm to meet its financial obligations. As such, many previous viability studies focused not only on the farm business, but actually analyzed the farm household by including household income and expenses in measuring viability. This study examines the viability of the farm business alone and excludes income and expenses generated off the farm. In this way, a better understanding of what makes the business of farming viable can be gained. Ultimately it is the viability of the farm itself that is paramount in sustaining agriculture.

The model conceptualization in this study begins with basic financial literature, leaning on the previous work of Adelaja and Rose (1988) and Adelaja, Derr, and Rose-Tank (1989) who have developed viability models to explain the impacts of land use zoning on viability. Previous studies have used proxies for economic viability such as the debt-to-asset ratio (DE), the viability ratio (VR), and cash flow (CF). Adelaja and Rose (1988) showed that CF has advantages over the DE and the VR. The DE may not be a good measure of economic viability because farms that are heavily financed may still be able to meet financial obligations. For example, large commercial farms are often highly mortgaged but still generate profits. The VR and the CF measures are similar; however, cash flow is measured in dollars. Therefore, the coefficients of the regressors will be measured in actual dollar terms. This study utilizes net cash income (a measure similar to CF) as a proxy for economic viability.

The net cash income (NCI) identity can be specified as follows:

$$NCI \equiv GFI - OE - PIPD. \qquad (1)$$

Gross farm income (GFI) is the sum of revenues from products sold, operating expenses (OE) are the production expenses associated with operating the farm (including labor and other inputs), and principle and interest payments on debt (PIPD) are the payments made to pay off the debt of the farm. Equation (1) is an identity. We know the components that make up NCI. What is being conceptualized here are the factors that contribute to differences in NCI among farms. For example, two farms that appear identical in GFI, PIPD and OE may have different NCI based on differences in socioeconomic and demographic characteristics. For example, one farm may have wild animal damage, right to farm conflicts, and/or local zoning ordinances. Another farm may have better access to customers and to supplies, and better local support. Hence, in specifying viability models, past studies have specified linear viability functions with socioeconomic variables included and with random error terms included to account for randomness in farmer behavior and characteristics.

Based on the above, an implicit function that explains farm viability can be specified as follows (Adelaja and Rose 1988, Adelaja, Derr and Rose-Tank 1989):

$$NCI_i = NCI_i\ (W_i, X_i, Z_i) \quad (2)$$

where NCI_i is the net cash income of the i^{th} farm (previously defined), W_i is a vector of variables depicting the financial characteristics of the i^{th} farm, X_i is a vector of farm structural factors for the i^{th} farm, and Z_i is a vector of the operator's socio-demographic and attitudinal characteristics for the i^{th} farm.[3] Based on previous literature, the farm financial characteristics include gross farm income, profitability, off-farm income, debt, revenue from land sales, and asset value (see Adelaja and Rose 1989). As argued above, the farm structural characteristics may include variables previously accounted for in past studies such as farm type, acres operated, region, and production practices, as well as variables such as and marketing practices, various problems faced and the business climate indicators. The operator's socio-economic and demographic characteristics may include age, education and experience. The attitudinal characteristics include farmers' planning horizon, and a host of variables that reflect how farmers feel about regulations, markets, business costs, taxes, and the availability of supplies. These are hypothesized to be significant determinants of viability.

Viability models can estimate the effects that these types of factors have on farm viability. A viability model is used in this study to estimate the effects that socio-demographic, attitudinal, and farm structure/environment variables have on viability.

DATA AND ECONOMETRIC MODEL

This analysis utilized data from the 1994 Survey of New Jersey farms.[4] Rutgers University researchers from the Department of Agricultural, Food and Resource Economics (AFRE) conducted the New Jersey farm survey. It was done in support of the efforts of the New Jersey FARMS

Commission.[5] Some 216 of the New Jersey farmers that had previously participated in the Farm Costs and Returns Survey (FCRS) conducted by the National Agricultural Statistics Service (NASS) were re-survey. The Economic Research Service (ERS) of the USDA conducts the FCRS annually.

The New Jersey farmer survey was designed to obtain information not only about the structure of farms, but also on other issues for which data typically do not exist. The survey questioned farmers about their socio-economic and demographic characteristics, as well as their opinions and attitudes about various regulatory, marketing, business climate, land use, farmland retention, production system, taxation, leadership, communication, and public policy issues. It also questioned farmers about their plans regarding land use, sale of land, investments and various other issues. The survey contained a total of 152.

The FCRS contained questions about aggregate farm expenses and incomes, as well as more detailed information about input use (by commodity category), revenues (by product category), cash expenses and field operations.[6] For example, information on seed, fertilizer, hired labor, contract labor, family labor, machinery used (by commodity), machinery operating-costs, and fixed costs (eg. depreciation) were available. Livestock, building and equipment values were derived from producers' descriptions of those used.

The supplemental survey was conducted by NASS enumerators hired by Rutgers University. They administered the survey to farmers involved in the 1991, 1992 and 1993 NASS survey. Each farmer was interviewed in person. Complete information was available for 206 of the farmers surveyed. The combined FCRS and NJ farmer survey served as the data source for this study.

As mentioned earlier, net cash income is used as a proxy for farm viability. Table 1 shows the distribution of NCI among the farmers surveyed. As the table shows, approximately 49% of the farmers surveyed had negative net cash income. Another 36% of the farmers surveyed had net cash income in the range of \$1 to \$25,000. It is obvious that the viability of many of these farms is significantly stressed. Explaining why is the reason for this study.

The empirical model specified to explain the viability of farms is as follows:

$$
\begin{aligned}
NCI_i = {} & b_0 + b_1\, IGFI_i + b_2\, YIELD_i + b_3\, ZOFI_i + b_4\, DTOT_i + b_5\, ZRLS_i + b_6\, ASSTVAL_i + \\
& b_7\, ENDEPR_i + b_8\, DNURSE_i + b_9\, DVEG_i + b_{10}\, DDAIRY_i + b_{11}\, DFRUIT_i + \\
& b_{12}\, DANIMAL_i + b_{13}\, REG1_i + b_{14}\, REG2_i + b_{15}\, REG3_i + b_{16} YEAR_i + \\
& b_{17}\, ACOPER_i + b_{18}\, ACOWNPCT_i + b_{19}\, DINCAC_i + b_{20}\, DDECAC_i + \\
& b_{21}\, DRTF_i + b_{22}\, DRTFCON_i + b_{23}\, DPINE_i + b_{24}\, DAGRIC_i + b_{25}\, EXPER_i + \\
& b_{26}\, OPERAGE_i + b_{27}\, OPEDUC_i + b_{28}\, DOPJOB_i + b_{29}\, PHORZ_i + \\
& b_{30}\, DCHEM_i + b_{31}\, DMKT_i + b_{32}\, PCTSALE_i + b_{33}\, INNOV_i + b_{34}\, INFOIND_i + \\
& b_{35}\, DAMCOST_i + b_{36}\, DDAMG_i + b_{37}\, REGFIN_i + b_{38}\, TAXIND_i + b_{39}\, POLIND_i \\
& + b_{40}\, MKTIND_i + b_{41}\, SUPIND_i + b_{42}\, DWAGE_i + U_{i.} \qquad (3)
\end{aligned}
$$

U_i is a random error term that is assumed to be normally distributed with zero mean and a constant variance.

The rationale for including many of the independent variables in Equation (3) can be found in previous studies on viability. For example, gross farm income (IGFI), gross farm income per acre (YIELD), off-farm income (ZOFI), total outstanding debt (DTOT), depreciation (ENDEPR), total value of farm assets (ASSTVAL), and revenue from land sales (ZRLS) are all financial related variables that have been included in most viability studies (see Adelaja and Rose 1988; Adelaja, Derr and Tank 1989). IGFI, a proxy for farm size, is expected to have a positive effect on NCI (Adelaja and Rose 1988). In theory, larger farms can operate more efficiently by taking advantage of economies of scale. The coefficient of YIELD, a measure of production intensity, should also be positive. No *a priori* expectations are formed about the coefficient of ZOFI since viability of the farm itself, not the farm family, is being modeled. Working off the farm may affect the viability of the farm positively by allowing greater investment in the farm or negatively by reflecting the operator's decreased interest in farming.

DTOT and ENDEPR may both negatively or positively affect viability. On the one hand, debt service adds a cost burden. On the other hand, technology and inputs financed by debt should represent greater productivity. A similar argument can be made about ENDEPR. Hence, no *a priori* expectations are formed about these variables. ASSTVAL and ZRLS are expected to positively affect viability based on the economies of scale argument and the argument that selling off land provides an internal source of capital to finance new technologies (see Adelaja, Derr and Tank 1989; Lopez, Adelaja and Andrews 1988).

Some basic socio-demographic variables such as operator age (OPRAGE), experience (EXPER), and education (OPEDUC) are also included. Adelaja and Rose (1988) argue that older farmers tend to have higher net farm income because they have lower debt and interest payments. Similarly, AGE and EXPER are expected to positively affect viability. A dummy variable indicating that the farmer has an off-farm job (DOPJOB) is included. The expectation is that part-time farmers are less interested in farming and therefore, they experience reduced farm viability.

Farmers who grow dissimilar products may face dissimilar challenges in their cultivation practices and in their markets. Therefore, five dummy variables were included to indicate the primary crop produced and to capture commodity group effects. The crop variables are nursery crops (DNURSE), vegetable crops (DVEG), dairy farms (DDAIRY), fruit and berry farms (DFRUIT), and poultry, livestock and horse farms (DANIMAL). The base crop is cash grain and field crops.

New Jersey is a very diverse state, containing areas ranging from extremely urban to extremely rural. Farms in different areas may face very different business circumstances, different soil types, or different external pressures from neighbors to be environmentally considerate. For these reasons, dummy variables for region were included. The region variables are central New Jersey (REG1), northern New Jersey (REG2), and northeast New Jersey (REG3). The base region is southern New Jersey. The southern region (Camden, Gloucester, Atlantic, Salem, Cumberland and Cape May counties) can be characterized as extremely rural and agricultural, although Camden County, which is adjacent to Philadelphia, is relatively urban and suburban. The central region (Middlesex, Mercer, Monmouth, Ocean and Burlington counties) can be characterized as mostly suburban with some rural/agricultural areas. The northern region (Morris, Sussex, Warren, Hunterdon and Somerset counties) is also a mixture of suburban and rural areas. The northeast region (Bergen, Hudson, Passaic, Essex and Union counties) is highly populated, considered the suburbs of New York City, and can be characterized as extremely suburban mixed with urban areas such as Newark.

Although the data is cross-sectional, many of the financial variables were collected from three different years (1989, 1990 and 1991). In 1989, the nation was in a recession and by 1991, recovery from that recession had begun. The variable YEAR is included to capture the effect of the health of the economy on farm viability.

Total acres operated (ACOPER) is included to allow estimation of the effects of farm size on farm viability. Based on the economies of scale argument, the expectation is that larger farms are more viable. Similarly, the percentage of acres farmed that is owned (ACOWNPCT) is included as a variable. Farmers who own their land are expected to be more viable because they have a more vested interest and the long-term utility of the land should be an issue to them. A dummy variable for farmers that have increased their acreage (DINCAC) is included. It is expected that increasing acreage leads to increased viability. Similarly, a dummy variable for farmers that have decreased their acreage (DDECAC) is included. The expectation is that by decreasing acreage lowers morale. This detracts from achieving the benefits of economies of scale, and leads to reduced viability.

A dummy variable that indicates whether or not a farmer has right to farm ordinances in his/her township (DRTF) is included due to the importance of this issue in urban fringe agriculture. The expectation is that these ordinances protect the farmer from nuisance complaints and increase viability. Also, a dummy variable indicating whether a farmer has experienced conflicts and complaints from neighbors (DRTFCON) is included. The expectation is that these conflicts and complaints actually reduce farm viability. A dummy is included for farms located within the NJ Pinelands (DPINE). On one hand, the stringency of regulations in this region may reduce farm viability. On the other hand, the elimination of speculative behavior may induce greater investments and dedication and therefore, greater viability. Similarly, the dummy variable for farms located within an agricultural zoning district (DAGRIC) will show a positive sign if agricultural zoning helps increase farm viability.

A dummy variable for low-input farming practices (DCHEM) is included to determine the effect of chemical reduction on viability. Some studies affirm that when farms convert to practices involving reduced use of chemicals, net farm income declines (Rendleman 1991). However, Painter et al. (1995) found that some reduced chemical systems had higher net income than the many profitable conventional systems. A dummy variable for farmers who utilize innovative marketing techniques (DMKT) such as road-side stands, U-Pick operations, farmers markets, etc. is included in order to examine if these practices enhance viability.

The percentage of total sales that a farmer generates from direct marketing (PCTSALE) is also relevant. Its coefficient is expected to show that direct marketing increases farm viability. A measure of innovation (INNOV) is included to test the relationship between farm financial success and the adoption of new practices. The variable reflects farmers who indicated that they have been able to increase production without farming additional land through various techniques such as double cropping, improved irrigation systems, improved fertilizer and herbicide management, etc.

An index that measures how extensively a farmer uses various information sources (INFOIND) such as other farmers, farm bureau, extension resources, and the department of agriculture is included. The expectation is that use of information has a positive impact on farm viability.

Damage to crops from wild animals is a major issue at the urban fringe. Animal damage represents a direct cost to farmers. A dummy variable indicating that a farmer has had animal damage (DDAMG) is included. Its coefficient will reflect whether or not animal damage reduces farm viability. Similarly, the amount that a farmer spends to prevent wild animal damage (DAMCOST) represents an added cost of production and may reduce viability. If the benefits of prevention outweigh the costs, the coefficient of DAMCOST will be positive, indicating that NCI and viability were improved because of the preventive action.

As mentioned above, the remaining variables, which attempt to capture farmers' attitudes about farming, business climate, and innovation in production and marketing, were not accounted for in previous studies. Planning horizon (PHORZ) is a measure of how long the farm operator plans to remain farming in New Jersey. In theory, farm operators with longer planning horizons will be more willing to invest in new technologies that increase profits and viability.

Five attitudinal indices that reflect the extent that farmers feel the business and regulatory climate in New Jersey have had negative financial effects on their operations were included in Equation (3). The regulatory index (REGFIN) is a summary index which measures the financial effect that farmers contend that regulations have had on the farm operation. REGFIN includes effects from all regulations, including local zoning, water use, waste disposal, taxes, and more. TAXIND is a measure of how the operator feels that high costs of doing business in the state have effected his/her operations. POLIND is a similar measure that addresses the political environment in New Jersey. MKTIND measures the degree to which farm operators feel that New Jersey's environment is not conducive to marketing their products. SUPIND measures farm operators' perceptions with respect to the degree of difficulty in obtaining farm supplies in New Jersey. A negative coefficient is expected for the 5 indexes listed above since the indexes measure the degree to which farmer operators feel these problems have negatively affected their farm operations.

Finally, a dummy variable is included that indicates whether or not a farmer feels that increases in minimum wage have added up to 25% increases to the farm's wage bill (DWAGE). Its coefficient will reflect if this added cost of production has reduced farm viability.

EMPIRICAL RESULTS

Equation (3) was estimated using simple linear regression. The parameter estimates for the model are shown in Table 2 under the heading of Model 1. Despite the fact that the data is largely cross sectional, the R-square is .8592. The high R-square is intriguing and suggests that the inclusion of factors not previously accounted for adds considerably to the model's explanatory power. Despite the high R-square, numerous variables are not statistically significant. This suggests, as well as the collinearity statistics that the model exhibited signs of multicollinearity.

When multicollinearity is present, least squared estimates are expected to be unbiased. However, the standard errors are biased upward so they are unreliable (Pindyck and Rubinfeld 1991). Ways to eliminate the problems associated with multicollinearity include increasing the sample size or decreasing the number of variables in the model. Procedures followed in an attempt to reduce multicollinearity are discussed below.

Certain variables were eliminated from Model 1 in an attempt to diminish the problems associated with multicollinearity. The process resulted in Model 2, the results of which are also shown in Table 2. A Chow F-test was used to determine if the coefficients of the variables that were eliminated are all statistically equal to zero. The calculated F statistic was .93; and it does not exceed the critical F value of 1.52. Thus, the null hypothesis that the coefficients of these variables are zero cannot be rejected. The conclusion is that the coefficients of the eliminated variables are all equal to zero, and that Model 2 is a better model than Model 1. A stepwise regression was also run to determine if the result would be similar to Model 2. The stepwise function performs an iteration process and chooses variables that best explain the dependent variable. The procedure results in an "optimal" model in terms of explanatory power. The results of the stepwise function shown in Table 2 indicate that Model 2 is near optimal given the initial set of variables.

Most of the financial variables have coefficients which are statistically significant. In addition, statistical significance is found with a number of commodity, regional, and business climate related variables. Furthermore, some of the operator personal characteristics and variables depicting the extent to which farmers are opportunistic are statistically significant. Specific findings are discussed next.

Examine first the estimated effects of the farm financial variables on viability. The coefficient of IGFI is statistically significant at the α=.05 level. It is also positive, as expected. This indicates that larger farms are more viable. The direct relationship between size and viability is consistent with the findings of Adelaja, Derr and Tank (1989) who found that for each dollar of gross farm income, cash flow increases by 21 cents. This study's estimate is in the neighborhood of 30 cents. The finding of a direct relationship between gross farm income and viability raises some concerns about the future of farming since it indicates that the declining size of the average farm in New Jersey implies decreasing viability.

The coefficient of gross farm income per acre (YIELD), a measure of production intensity, is also statistically significant at the α=.05 level. Furthermore, it is positive, as expected. This finding has an important implication. That is, a farm that utilizes its land better by moving toward high-value crops is more viable. The encouragement of high value products such as nutraceuticals, specialty vegetables, specialty ornamentals, and exotic animals has been at the center of economic development policy in near urban states such as New Jersey. For example, New Jersey implemented the Business Incentive Grant (BIG) and Production Efficiency Grant (PEG) programs to encourage farmers to modernize and improve product value via grants. This finding lends credence to such policies.

The off-farm income (ZOFI) coefficient is not statistically significant. This result is not surprising since the viability of the farm itself is being modeled, not the viability of the farm family. The implication here is that working off the farm does not affect the viability of the farm, either positively through increased investment in the farm, or negatively through decreased interest in farming. This finding offers a challenge to those that criticize part-time farming in and of itself as a source of declining farm viability.

The coefficient of outstanding debt (DTOT) is statistically significant at the α=.05 level and is negative, as expected. This result is not surprising. It suggests that borrowing does detract from the viability of the farm because of the costs associated with servicing debt. However, the coefficient of debt only looks at "one side of the coin." Investments in new technology, additional land, etc. which may require taking on additional debt, often increase farm viability as shown above in the discussion of IGFI and farm size. The point of the finding is that the negative effect is dominant in the short-run.

One of the arguments at the urban fringe is that farmers need access to their equity and revenue from land sales because these are used as internal sources of credit to finance new technology needed to remain competitive. Revenue from land sales is not statistically significant. Neither was it in the Adelaja, Derr and Tank (1989) study. This finding implies that when farmers sell their land or part thereof, the funds are not used in ways that farm viability is enhanced.

The coefficient of value of assets (ASSTVAL) is statistically significant and negative. However, the magnitude of the coefficient is minimal. This runs counter to the economies of scale and size arguments. However, the very low value is noteworthy. The coefficient of depreciation expense (ENDEPR) is only significant in the stepwise regression.

Examine, next, the commodity and regional dummy variables included in the model to isolate commodity and regional group effects. Of the five farm type dummy variables, the only coefficient that is statistically significant is the dummy variable for vegetable farms (DVEG), but it is only significant in Model 1 and the stepwise regression. The coefficient of DVEG is negative for all three models shown in Table 2, suggesting that vegetable farms are less viable than field crop farms. This result seems surprising at first. However, considering that the model accounts for other factors such as farm size, production intensity, etc., it should not be surprising that vegetable farms are less viable, *ceteris paribus*. That is, vegetable farming is a tough and competitive business. Even though vegetable farms make more, it seems that they do so because they are larger and because they are structurally different.

Of the three regional dummy variables, only one coefficient was statistically significant. The coefficient of northeast New Jersey is statistically significant at the α=.05 level and negative in all three models. This finding suggests that after accounting for all other factors, on average, farms in this region are less viable by approximately $140,000 annually. The northeast region is highly populated, is mostly urban, and is dotted with some suburban areas. It is one of the first areas that experienced development as a direct result of the outflux of people from New York City into New Jersey's suburbs. Agriculture in this region has lost its "critical mass", and the infrastructure for agriculture is largely nonexistent. The stressed financial position of farmers in this region should be a wake up call to everyone. The nature of agriculture in this region may be a foreshadowing of what is to come for areas that are currently rural but on the brink of development.

The coefficient of the dummy variable for farmers indicating that they had decreased their acreage in the previous five years (DDECAC) is significant at the α=.10 level. It is also negative as expected. This finding further supports the hypothesis that smaller farms are less viable because they are not taking advantage of economies of scale. However, the finding also indicates that farms that have sold off land experience further erosion in their survivability. Again, this finding is disconcerting given that the average farm size is decreasing at the urban fringe.

The coefficient of the local right to farm ordinance dummy variable (DRTF) is not statistically significant, suggesting that the adoption by a municipality of a local right to farm ordinance aimed at protecting farmers does not enhanced the viability of farms in such locations. This finding may indicate that these ordinances have largely been symbolic, with their provisions essentially weak. According to Adelaja et al. (1996), these ordinances vary in their protective mechanisms. The coefficient of right to farm conflicts (DTRFCON), however, is significant at the α=.05 level and is negative in all three models. This result indicates that, although right-to-farm laws protect farmers from nuisance complaints from neighboring residents, such complaints cause farmers to alter, and outright curtail, lucrative productive activities, with the result that farm viability is actually decreased. In related work by Adelaja, Sullivan and Govindasamy (1998), it was discovered that nuisance complaints induce farmers to reduce their use of chemicals. Such reductions in chemicals can have implications for profitability.

The magnitude of the coefficient suggests that nuisance complaints ultimately reduce farm viability an average of approximately $25,000 annually per farm. Approximately 16% of the farmers surveyed experienced right to farm conflicts in the previous five years. Extrapolating that figure to the population of approximately 8,400 New Jersey farms gives an estimated 1,440 farms experiencing right to farm conflicts in the previous five years. This translates to a total estimated cost of right to farm conflicts for New Jersey farmers of $33.6 million annually. This staggering figure represents 12 percent of NJ’s 1996 net farm income. It suggests the importance of improving on the effectiveness of right to farm laws.

The finding regarding right to farm conflicts is remarkably important. New Jersey passed its state-wide right to farm law in 1983. Since then, farmers have complained about the weakness of this law and related state programs. Indeed, in six Superior Court cases, the court affirmed that the 1983 law lacked the municipal preemption which may have been initially intended (Adelaja et al. 1996). Adelaja et al. (1996) identified the weaknesses of the law and recommended seven strategies to improve the law and program. Based on the study, the state legislature introduced a revised right-to-farm law, which passed and was signed into law in July of 1998. The finding in this study lends credence to this new law.

Referring back to Table 2, the coefficients of the dummy variables for farms in agricultural zoning (DAGRIC) and farms in the Pinelands (DPINE) are both not statistically significant. Therefore, it appears that the location of a farm within a designated agricultural zone has no effect on the viability of the farm. The finding that the coefficient of DPINE is insignificant suggests that the land use regulations promulgated by the New Jersey Pinelands Commission appear to have had no adverse effects on farm viability.

The Pinelands finding is important in light of the findings by Adelaja, Derr and Rose-Tank (1989) and Rose (1986) that farms in the Pinelands exhibited increased production expenses, lower efficiency and profitability, and devaluation of land assets. These studies were conducted in 1984, shortly after the creation of the Pinelands Comprehensive Management Plan in 1979. It is plausible to suggestthat the change in 1979 created a dis-equilibrium in the performance of farmers. However, the finding in this study suggests that whatever short-term disadvantages Pinelands farmers experienced in viability no longer exist.

The coefficient of operator age (OPERAGE) is statistically significant and negative in the stepwise regression, indicating that older farmers operate less viable farms. This is consistent with the findings of Adelaja and Rose (1988) and Adelaja, Derr and Rose-Tank (1989). Obviously, older farmers have less vigor and are perhaps less innovative. The insignificance of experience is noteworthy.

The coefficient of operator education (OPEDUC) is statistically significant and positive in Model 2, suggesting that education does pay off in the farming business. The estimated coefficient is about $4619 for each level of education attained. A college degree is represented as a "3" in measuring the variable OPEDUC. Assuming an annual cost of education of $15,000, a four year college degree cost of $60,000, and a productive life of 45 years for farmers, the total return to a college degree would be $207,855. This suggests an imputed return of 246 percent.

The coefficient of planning horizon (PHORZ) is not statistically significant, indicating that farmers who indicated that they had long-term plans to farm are no more viable than farmers with a short-term outlook. This suggests that long-term interest does not contribute to viability, but does not indicate whether farmers that are viable have longer planning horizons.

The coefficient of the reduced chemical practices dummy variable (DCHEM) is not statistically significant. It therefore appears that farmers that have reduced chemical uses (e.g. organic and IPM) do not experience a reduction in farm viability. Considering the findings by others that reduced chemical use has adverse effects on profitability, the finding here is a useful piece of information to those concerned about the environment. The coefficient of innovative marketing techniques (DMKT) is positive in all models, although only statistically significant in the stepwise regression. Nonetheless, the results suggest that farmers that creatively market their products are more viable.

The coefficient of innovative farmers (INNOV) that are increasing their productivity without increasing acreage is statistically significant at the α=.05 level and negative in all three models. The *a priori* expectation was that this coefficient would be positive. However, the negative coefficient can be explained on the basis of the investment effect. Farmers that increase productivity by investing in new technology or equipment also have to service more debt.

The coefficient of the variable that measures how extensively farmers utilize information (INFOIND) is statistically significant at the α=.10 level and is positive in all three models. Farmers that utilize information from sources such as extension, department of agriculture, and others have more viable farms because of it. The programs designed to equip farmers with important information and ultimately enhance the viability of farming appear to be achieving their intended results.

The INFOIND finding is explored further because of its importance with respect to the utility provided by the various infrastructures in place to support farmers. The result suggests an $8920 premium associated with a farms reliance on any one support service. Seventy-seven percent of the farmers surveyed in the 1994 Survey of New Jersey farms relied on Rutgers Cooperative Extension for information. Expanding that to the 8,400 total farmers in New Jersey, one can calculate a total benefit of $57 million to New Jersey farmers from using Rutgers Cooperative Extension services. This is a remarkable return.

Two out of the five attitudinal indices that indicate farmers feelings towards the business climate in New Jersey have statistically significant coefficients. The coefficient of marketing index (MKTIND) is statistically significant at the α=.10 level and negative in Model 2. This suggests that MKTIND does help explain viability. Farmers who feel that the environment in New Jersey is not conducive to marketing their products may have a reason to feel that way; these farmers are operating less viable farms. The coefficient of supply index (SUPIND) is also statistically significant at the α=.10 level and is negative in Model 1. Farmers who feel that it is difficult to procure supplies in New Jersey are operating less viable farms.

It is important to note that some of the attitudinal variables in this analysis are rooted in feeling, perspective and opinion. They do not necessarily indicate whether or not in reality, farmers face poor market conditions, have difficulty obtaining supplies, etc. The fact that for farmers who believe that it is tough to farm at the urban fringe, farm viability is compromised, suggests that attitudes are important factors to consider in studying the behavior of urban fringe farmers.

SUMMARY AND CONCLUSIONS

At the urban fringe, concern over the loss of agricultural land. Many argue that farmland at the urban fringe cannot be sustained unless it is viable, regardless of the preservation policies in place to protect it. Yet very little is known about the factors that contribute to the viability of agriculture at the urban fringe. This study adds to the knowledge base on farming at the urban fringe in numerous ways.

The finding that right to farm conflicts decreases the viability of agriculture is an important finding. Direct empirical evidence about the effects of right to farm conflicts had never been presented. The estimated $33.6 million decline in net cash income associated with right to farm conflicts in New Jersey is cause for serious concern. Policy makers seem to be addressing this issue in New Jersey by implementing a new right to farm law.

The finding that farmers who utilize information from sources such as extension run more viable farms is also an important finding. This suggests that these information sources provide valuable services to farmers and society. In the near future, as agriculture becomes even more competitive due to the lifting of price supports by the federal government with the 1996 FARM Act, information may be even more important in keeping urban fringe farms competitive. The challenge to urban fringe farmers is to remain viable in the increasingly competitive environment.

Farms that utilize their land more intensely or grow high value crops are more viable. This finding supports the argument that urban fringe farmers should be thinking about growing higher value, alternative crops such as herbals, medicinal plants, nutraceuticals which may provide more income per acre and increase viability. However, in a recent study by Adelaja, Sullivan and Govindasamy (1998), it was discovered that smaller farms that grow higher-value crops (e.g. vegetable and nursery crops) find it more difficult to decrease their chemical use. Thus, the future holds a unique challenge to balance the dual priorities of increasing viability while maintaining a sustainable agriculture at the urban fringe.

The finding that larger farms are more viable is not new. However, the results here should be of concern. Farm size continues to decline at the urban fringe. Farmers often sell small parcels of land to help pay the bills and remain farming. However, the finding that selling off parcels of farmland is actually erodes viability indicates that the loss of farms will continue to erode viability which in turn causes further loss of farms. This notion is further supported by the finding that viability is limited for farms in northeast New Jersey. Farmers in the remainder of the state, as well as all other urban fringe farmers, can expect the same inhospitable conditions if development and land loss continue.

Table 1: Distribution of Net Cash Income for the New Jersey Farmers Surveyed

Net Cash Income	Percentage	Cumulative Percentage
-400,000 to -350,000	1.0%	1.0%
-249,999 to -200,000	0.5%	1.5%
-199,999 to -150,000	0.5%	2.0%
-149,999 to -100,000	2.0%	3.9%
-99,999 to -50,000	6.9%	10.8%
-49,999 to -25,000	6.4%	17.2%
-24,999 to 0	31.5%	48.8%
1 to 25,000	36.0%	84.7%
25,001 to 50,000	6.4%	91.1%
50,001 to 100,000	3.4%	94.6%
100,001 to 150,000	2.5%	97.0%
150,001 to 200,000	1.0%	98.0%
250,001 to 300,000	0.5%	98.5%
350,001 to 400,000	0.5%	99.0%
550,001 to 600,000	0.5%	99.5%
850,001 to 900,000	0.5%	100.0%

Source: Adelaja, A., 1994 Survey of New Jersey Farms.

Table 2: Parameter Estimates of the Viability Models for New Jersey Farms.

Variable	Model 1		Model 2		Stepwise		Description
INTERCEPT	3094294		-6646.767		34423.653	**	Intercept
IGFI	0.3469	*	0.300	*	0.332	*	Gross Farm Income
YIELD	1.6454	*	1.759	*	1.683	*	Income per acre
ZOFI	-0.0878						Off Farm Income
DTOT	-0.2379	*	-0.268	*	-0.240	*	Outstanding Debt
ZRLS	-0.1088						Revenue from Land Sales
ASSTVAL	-0.0033	**	-0.004	*	-0.003	**	Value of Assets
ENDEPR	-0.3412				-0.616	*	Depreciation Expense
DNURSE	-14368						Nursery Crops
DVEG	-38626	*	-15979		-24673.006	*	Vegetable Farm
DDAIRY	1599.7937						Dairy Farm
DFRUIT	-12287						Tree Fruit and Berry Farm
DANIMAL	-6389.1452						Poultry Cattle Horse Farm
REG1	14479		4183.403				Central New Jersey
REG2	-168.9672		1631.318				North-West New Jersey
REG3	-140968	*	-141844	*	-38159.541	*	North-East New Jersey
YEAR	-1549.5146						Year
ACOPER	-20.6174						Acres Operated
ACOWNPCT	1814.1321						Acres Owned Percentage
DINCAC	-6129.5415						Increased Acreage
DDECAC	-12196		-15996	**			Decreased Acreage
DRTF	-5835.6967						Right-to-Farm
DRTFCON	-23494	*	-25485	*	-20772.148	*	Right-to-Farm Conflicts
DPINE	-19928						Farm within Pinelands
DAGRIC	-556.7257						Agricultural Zoning
EXPER	303.4534						Operator Experience
OPERAGE	-508.5613				-536.719	**	Age of Operator
OPEDUC	3950.7475		4619.216	**			Education of Operator
DOPJOB	6581.8206						Operator Off Farm Job
PHORZ	201.4858						Planning Horizon
DCHEM	5191.4902						Alternative Chem. Use
DMKT	14247		12280		15515.504	**	Innovative Marketing
PCTSALE	89.2362						% sales from Retail
INNOV	-5902.6205	*	-5702.557	*	-6271.888	*	Innovation Index
INFOIND	12288	**	8920.803	**	10298.207	**	Use of Information
DAMCOST	3.3396						Animal Dam. Prev Cost
DDAMG	9427.5767						Animal Damage
REGFIN	32.1452						Regulation Index
TAXIND	-771.1660						Tax & Business Cost Index
POLIND	-1069.5388						Political Environment Index
MKTIND	-5034.4022		-5057.0118	**	-4659.767		Marketing Index
SUPIND	-14056	**					Farm Supplies Index
DWAGE	-4094.6651						Minimum Wage Effect
R-Squared	.8592		.8315		.842		
Adj. R-Squared	.8131		.8174		.829		
DW Statistic	2.144		1.97		2.07		

A single asterisk (*) indicates that the coefficient is significant at the α=.05 level. A double asterisk (**) indicates that the coefficient is significant at the α=.10 level.

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ENDNOTES

[1] There are many public policies designed to market agricultural products with the notion that it will have a positive effect on the viability of agriculture. In New Jersey, for example, the "Jersey Fresh" program uses television, newspaper and trade publication advertisements to increase product awareness and support the marketing of specific agricultural commodities. Value added agriculture is being promoted with the expectation that it will increase the viability of agriculture.

[2] A number of research programs have focused on increasing innovation in agriculture. For example, New Jersey implemented a farm management-training program intended to arm farmers with better, more up to date information. In New Jersey, the Agricultural Economic Recovery and Development Initiative (AERDI) was implemented in 1993 to spur investment in the agricultural sector. AERDI's Production Efficiency Grants (PEG) and Business Incentive Grants (BIG) provide incentives for farmers to invest in technology and equipment, and to join or form cooperatives in order to increase production efficiency. All of these programs attempt to enhance the viability of agriculture.

[3] Adelaja and Rose (1988) introduced the concept of simultaneity in modeling economic viability. However, due to the greater complexity of this model, the simultaneous equation approach is not used in this analysis.

[4] Researchers had to obtain USDA and congressional approval in order to re-survey the farms previously surveyed as part of the FCRS.

[5] The 1994 Survey of New Jersey Farms was conducted to support two of the goals of the New Jersey FARMS commission: gaining understanding of New Jersey agriculture and exploring ways to increase its viability and sustainability.

[6] The sample was selected to be fully representative of New Jersey agriculture. The distribution of farms by size, income, commodity group, etc was considered in selecting specific representative farms. The fact that the sample is representative of the population allows the use of expansion factors in drawing population-wide inferences.